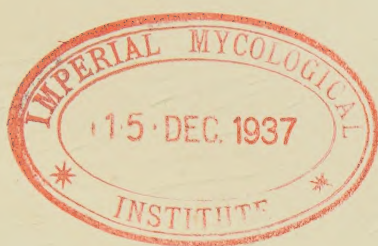


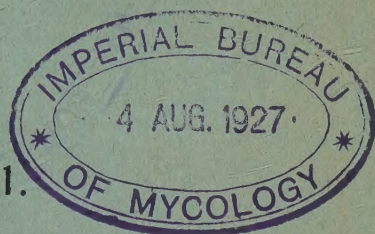


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THE
Tea Research Institute
OF
Ceylon.

BULLETIN No. 1.



Annual Report for the Year 1926.



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THE TEA RESEARCH INSTITUTE OF CEYLON,
VICTORIA COMMEMORATION BUILDINGS, KANDY.

TEA RESEARCH INSTITUTE.

BOARD OF CONTROL.

Chairman :—Mr. John Horsfall.

The Hon'ble the Colonial Treasurer.
The Hon'ble the Director of Agriculture.
The Chairman, Planters' Association of Ceylon.
The Chairman, Ceylon Estates Proprietary Association.
Mr. D. S. Cameron.
Mr. W. Coombe.
Mr. H. Hopwood.
Col. T. G. W. Jayawardena.
The Hon'ble Mr. J. W. Oldfield.
Mr. T. B. Panabokke.
Mr. M. L. Wilkins.

Headquarters of the Board :

Victoria Commemoration Buildings, Kandy.

SCIENTIFIC STAFF.

Director :—T. Petch, B.A., B.Sc.

C. H. Gadd, D.Sc.	..	Mycologist.
D. I. Evans, B.Sc., Ph. D.	..	Biochemist.
S. Stuart Light, A.R.C.S., D.I.C.	..	Entomologist.

Laboratories :

The Tea Research Institute, Nuwara Eliya.

All communications concerning the scientific and advisory work of the Institute should be addressed to the Tea Research Institute, Nuwara Eliya.

REPORT

OF THE

Board of the Tea Research Institute of Ceylon

FOR 1926.

Members of the Board :—On January 1st the Board consisted of the following Members :—

Ex-Officio Members :—

1. The Director of Agriculture, (The Hon'ble Mr. F. A. Stockdale).
2. The Colonial Treasurer, (The Hon'ble Mr. W. W. Woods).
3. The Chairman, Planters' Association of Ceylon, (The Hon'ble Mr. J. W. Oldfield).
4. The Chairman, Ceylon Estates Proprietary Association (Mr. G. C. Slater).

Nominated Members :—

- | | | |
|--|---|--|
| <ol style="list-style-type: none"> 5. Mr. R. G. Coombe 6. Mr. M. L. Wilkins 7. Mr. D. S. Cameron 8. Mr. H. F. Parfitt 9. Mr. P. A. Keiller 10. Mr. J. D. Finch Noyes | } | Nominated by The Planters' Association of Ceylon. |
| <ol style="list-style-type: none"> 11. Col. T. G. Jayawardene 12. The Hon'ble Mr. T. B. Panabokka. | } | Nominated by The Ceylon Estates Proprietary Association. |
| <ol style="list-style-type: none"> 11. Col. T. G. Jayawardene | } | Nominated by The Low-country Products Association of Ceylon. |
| <ol style="list-style-type: none"> 12. The Hon'ble Mr. T. B. Panabokka. | } | Nominated by His Excellency The Governor. |

The Hon'ble Mr. J. W. Oldfield was elected Chairman at the first Meeting of the Board on the 7th January.

*March :—*Mr. Oldfield resigned the Chairmanship of the Planters' Association of Ceylon and was succeeded by Mr. George Brown.

Mr. G. C. Slater resigned the Chairmanship of the Ceylon Estates Proprietary Association and was succeeded by Mr. H. F. Parfitt who was succeeded on the Board by Mr. J. W. Oldfield.

*April :—*Mr. D. S. Cameron went on leave and was succeeded by Mr. John Horsfall.

*July :—*Mr. R. G. Coombe went on leave and was succeeded by Mr. C. Du Pre Moore.

*October :—*Mr. R. G. Coombe returned and resumed his seat on the Board.

*November :—*Messrs. H. F. Parfitt and P. A. Keiller went on leave and were succeeded by Messrs. W. Coombe and H. Hopwood.

Mr. D. S. Cameron returned from leave and relieved Mr. John Horsfall, but as Mr. R. G. Coombe had to go on sick leave, Mr. Horsfall took his seat.

Mr. J. W. Oldfield announced that he was shortly going on leave and the Board elected Mr. R. G. Coombe to act for him, and elected Mr. Horsfall to act as Chairman till Mr. Coombe's return.

Meetings :—During the year the Board held 3 Meetings in Kandy and 2 in Colombo, the average attendance at which was 10.

The Board wishes to record its thanks to the Ceylon Chamber of Commerce for lending the Committee Room for Meetings held in Colombo.

Scientific Staff :—

Director :—Mr. T. Petch, Director of the Institute, commenced his duties in Ceylon on 8th March.

Mycologist :—By arrangement with the Director of Agriculture Dr. C. H. Gadd joined the Staff on 1st July.

Entomologist :—Mr. S. Stuart Light commenced his duties in Ceylon on 17th May.

Biochemist :—Dr. D. I. Evans commenced his duties in Ceylon on 6th, September.

Agricultural Chemist :—Negotiations are in progress.

Temporary Laboratory :—By arrangement with Col. T.G. Jayawardene, V.D., a temporary laboratory has been established at "Lindfield," Nuwara Eliya. The lease is for 2 years with the option of renewal.

Experiment Station :—The Board wishes to acquire either by purchase or lease an estate or part of an estate at any elevation between 2,500' and 4,500', area 100 to 150 acres, fairly flat in places and fairly steep in others, of easy accessibility and in a district which does not get an excessive rainfall.

Eighteen estates have been considered, but it has not been possible to acquire any one of them.

Administration :—The Board has adopted a set of 14 Bye-laws.

Finance :—With the consent of the Board the surplus funds have been invested as follows :—

Rs. 25,000 on short time fixed deposit. Expired 19th November, 1926.

Rs. 25,000 on short time fixed deposit. Expired 16th December, 1926.

In December Rs. 100,000 was placed on fixed deposit for a period of one year.

The question of investing in mortgages on immovable property in Ceylon has been considered, but it was decided that the surpluses should be invested in more easily realizable securities.

Statement of accounts and balance sheet are attached.

By Order of the Board,

A. W. L. TURNER,

Secretary.

Tea Research Institute of Ceylon.

Kandy, 25th January, 1927.

REPORT OF THE DIRECTOR, TEA RESEARCH INSTITUTE OF CEYLON, FOR 1926.

I arrived in Ceylon on March 8th, and took up work in temporary quarters in Kandy. Beginning in June, I attended meetings of the District Planters' Associations, and explained the proposed work and organisation of the Institute. Up to date, the Uva, Madulkelle, Kalutara, Maskeliya, Dickoya, Sabaragamuwa, Ambegamuwa, Kandy, Pussellawa, Kotmale, Uda Pussellawa, Nuwara Eliya and Galle Planters' Associations have been met.

Estate for the Tea Research Institute :—Eight estates have been inspected and reported upon from the point of view of their suitability as the headquarters of the Institute.

Laboratory :—Pending the acquisition of an estate, it was decided that a temporary laboratory should be opened in the tea area, where accommodation for the staff could be obtained. Various buildings were inspected in Kandy, Hatton and Nuwara Eliya, but only the latter afforded the facilities required. A bungalow for a laboratory was selected in April, and possession was obtained on July 1st. This bungalow, formerly known as Lindfield, is in a central position, near the Grand Hotel Road, has water and electricity laid on, and is not shut in by trees or adjacent buildings. It has been re-roofed, and the floor put in order by the landlord.

The building contains an enclosed verandah which is being used as a conservatory for growing plants for inoculation with disease fungi or for rearing insects ; two large well-lighted rooms which serve as work rooms for the mycologist and the entomologist respectively ; library and reading room ; two communicating rooms which are being fitted up for the work of the biochemist ; Director's office ; store room, which has been fitted with shelving ; clerk's office ; sterilising room, fitted with the necessary sink, taps, etc. Teak tables have been provided for the work rooms, and a chemist's bench fitted with water and gas is being erected in one of the biochemist's rooms.

A Willett Petrol Gas Plant has been received from England and is in process of erection. This will serve the requirements of the chemists, and provide regulated heating for mycological work. General heating, e.g., autoclave, sterilisers, drying ovens, still, etc., is being done by kerosene stoves.

The Gas Plant is installed in the kitchen block, which consists of three rooms, with annexes. Part of one room has been converted into a dark room. Another room will be utilised by the chemists jointly, and will be fitted with a fume chamber for major operations, combustion furnace, etc. The third room in this block and a room in the main buildings are available for the agricultural chemist.

Apparatus, *e.g.*, microscopes, autoclave, etc., for mycological and entomological work, and general glass ware and chemicals, was purchased in England at the beginning of the year, so that work could start as soon as accommodation was available. Further apparatus is on order.

Library :—Standard reference books are being acquired.

The Indian Tea Association has placed the Institute on the free list for its Quarterly Journal and Bulletins, and has kindly presented us with all the available back numbers of each.

The Proefstation voor Thee, Java, has kindly given us all the available back numbers of De Thee and has placed the Institute on the free list.

The Institute has been placed on the free list, as from January 1st, 1926, for the *Tropical Agriculturist* and certain publications of the Ceylon Department of Agriculture, viz., the Bulletins, Leaflets, Annual Reports, and the *Annals of the Royal Botanic Gardens, Peradeniya*. We have purchased the numbers of the Circulars, Royal Botanic Gardens, Bulletins of the Department of Agriculture, Peradeniya Manuals, Annals of the Royal Botanic Gardens, and Leaflets, issued prior to that date, which we required.

From the Imperial Bureau of Mycology, we receive gratis, per the Ceylon Department of Agriculture, the *Review of Applied Mycology* from January, 1926, and similarly, from the Imperial Bureau of Entomology, the *Review of Applied Entomology* from January, 1926, and the *Bulletin of Entomological Research* from July, 1926.

By purchase, the Library receives the *Journal of Economic Entomology* and the *Journal of Agricultural Research*; and on loan, *Nature* and the *Bulletin de la Société Mycologique de France*.

A classified card catalogue of books and papers relating to tea has been instituted.

It is almost impossible to obtain at this date complete files of the standard journals and series of bulletins relating to tea, very many of the earlier numbers being out of print. The Institute would be glad to receive any copies of old books or pamphlets on the subject, for which their owners have no further use. Deficiencies are being remedied at present by making typewritten copies of the more important pamphlets, but in some instances there are no copies in Ceylon.

A catalogue of the library is annexed to this report. The books and periodicals may be consulted by planters, but may not be removed.

The thanks of the Board are due to the Director of Agriculture for his permission for the staff to consult the Library at Peradeniya and for the loan of books.

Staff.

Dr. C. H. Gadd, D. Sc. Birmingham, formerly Lecturer in Agricultural Biology and Agricultural Adviser, Cheshire Agricultural College, and

Lecturer in Agricultural Botany, University of Manchester, 1912-14. war service in France, September, 1914-1919, Assistant Mycologist, Department of Agriculture, Ceylon, 1919-1926, joined the staff of the Institute on July 1st, 1926. Dr. Gadd has carried on investigations on the *Cercospora* leaf disease of tea, *Acacias*, etc., and has succeeded in developing the perithecial stage of the fungus in culture. He has also begun the investigation of some of the phenomena classified under the name Witches' Broom of Tea, and of wood rot at higher elevations. The preliminary examination of the latter problems has shown the necessity of ascertaining at least some elementary information regarding the physiological processes of the tea bush, and Dr. Gadd has begun several investigations and experiments directed to this end.

Dr. D. I. Evans, B. Sc. Wales, Ph. D. London, war service 1915-18, formerly Research Scholar, Aberystwyth, and Research Scholar, Ministry of Agriculture, in Biochemistry, Imperial College of Science, was selected as Biochemist in January and arrived in Ceylon on September 6th. Dr. Evans has since been engaged in preparing the reagents and apparatus required in his work and standardising methods of analysis. He has also begun an investigation of the seasonal changes of some of the constituents of the fresh and withered leaf.

Up to the present, Dr. Evans has visited factories only in the neighbourhood of Nuwara Eliya, it being thought better that he should familiarise himself with conditions in one district before proceeding to examine the varying methods of factory practice in general.

Mr. S. Stuart Light, D.I.C., war service 1918-1919, formerly Research Scholar of the Ministry of Agriculture, Long Ashton Research Institute, and subsequently assistant to Professor H. M. Lefroy at the Imperial College of Science, was selected as Entomologist in January, 1926, and arrived in Ceylon on May 17th. Shortly after his arrival, Mr. Light toured the Badulla, Passara, Madulsima, Haputale, Ratnapura, Matale and Uda Pussellawa districts to gain a general acquaintance with tea cultivation, and has since visited Maskeliya, Dimbula, etc., in connection with Tea Tortrix and other pests.

Agricultural Chemist:—Negotiations are in progress for an Agricultural Chemist, who will undertake the investigation of soils and manures and supervise manurial experiments.

The subordinate staff consists at present of a motor driver, a clerk, a peon, and a cooly.

Work of the Staff.

The time of the Director has been occupied largely in visits to District Planters' Associations to explain to them the aims of the Institute and to obtain their views concerning the lines of work it should undertake; and in planning and purchasing furniture and fittings for the Laboratory.

The correspondence passing through the Director's hands comprises 876 letters in and 537 letters out since July 15th. Reports have been furnished on visits to the Planters' Associations and memoranda on various subjects. Much of the correspondence has necessarily been with local firms regarding apparatus, etc., for the laboratory. The Director has dealt personally with correspondence from planters relating to cover crops and weeds.

Attempts are being made to establish small plots of leguminous plants found wild in the Nuwara Eliya District.

After consultation with the Director of Agriculture, it has been arranged that the Department of Agriculture shall continue its investigations on Termites, Green Bug and Brown Bug, while the Institute takes over from the Department Tea Tortrix and Shot-hole Borer. Similarly as regards diseases, the Department will continue its work on root diseases caused by *Rhizoctonia bataticola*, and Wood Rot where associated with Termites, while the Institute will take up Wood Rot at higher elevations, and all other diseases of the tea bush.

The focussing of attention on the needs of the Tea Industry has immediately brought to light the necessity of acquiring some knowledge of the life processes of the tea bush. Attempts are now being made by practical men to introduce systems of manuring and pruning which have for their main object the renovation of "cankered" bushes and the prevention of further deterioration of this character, and these attempts are usually justified by arguments based on alleged facts in the physiology of the bush. But such statements are usually purely general. Practically nothing is known of the physiological processes of the tea bush in particular. Although the tea industry has been in existence in Ceylon for fifty years, we know far less about the tea bush than we do about the rubber tree, probably because the tea industry was established at a time when scientific investigation had not been applied to agriculture, except from the chemical standpoint. Yet after all the tea bush is the basis of the tea industry.

Many of the alleged reasons for pruning practices, current and proposed, are demonstrably incorrect. Regeneration after pruning, healing of wounds, growth of roots in relation to pruning, storage of plant food, etc., are essentially physiological problems which cannot be solved by purely manurial experiments. Moreover, methods of treatment evolved in other countries, in which climatic conditions are different from those in Ceylon, cannot be adopted here blindly, without risk of disaster. A beginning has been made in the investigation of fundamental principles, but the problems involved in pruning constitute easily the most serious feature of tea research in Ceylon and should receive the fullest possible attention.

The thanks of the Institute are due to Mr. C. D. Sparkes, Manager of the Ceylon Tea Plantation Co., and to Mr. P. A. Kelly, Superintendent of Scrubs Estate, for their assistance in providing supplies of leaf, and to Mr. E. C. Elliott, Pedro Estate, and Mr. A. T. Sydney Smith, Diyanila Kele, for the supply of material for investigation.

Reports of the Scientific officers are appended.

T. PETCH,
Director,
Tea Research Institute.

REPORT OF THE MYCOLOGIST.

I joined the staff of the Tea Research Institute of Ceylon on July 1st, 1926. This report covers the period from that date until the end of the year.

Advisory Work :—One hundred and twenty-five letters have been received and one hundred and fourteen despatched. Fifty-six consignments of diseased plants have been received for examination and report. Of these 44 were tea, 7 *Albizzia lophantha*, and 1 each of Acacia, Dadap, Grevillea, Eucalyptus, and *Albizzia moluccana*. Of the tea consignments, 15 were root diseases, 10 leaf diseases, 6 stem diseases, 8 seedling diseases and 5 miscellaneous.

Visits have been made to 10 estates at the request of the Superintendents, in order to carry out investigations and make recommendations in the field.

Co-operation :—Close touch has been maintained with the Mycological Division of the Department of Agriculture in order to prevent any overlapping of investigations. I would here acknowledge my indebtedness to Dr. W. Small, Government Mycologist, for his willing co-operation and for the assistance he has generously given. I am also indebted to Prof. N. G. Ball of the Botany Department of University College for the loan of literature. My thanks are also due to the Superintendents of many estates for assistance in carrying out investigations in the field, for the provision of research material, and for the information they have willingly supplied.

Cercospora Leaf Disease :—The most serious leaf disease on tea at the present time in Ceylon is, undoubtedly, that caused by the fungus *Cercospora Theae*. The disease has been fully described by Mr. Petch in his book "The Diseases of the Tea Bush," in which he states that this disease first attacks Acacias and then spreads from them to the tea. Mr. Petch's observations have been fully confirmed by laboratory experiments, in which the fungus has been isolated from the leaflets of *Acacia decurrens* before they have fallen off the tree, from leaflets which have fallen and adhered to tea leaves, and from the characteristic diseased spots on tea leaves. The experiments demonstrate beyond all doubt that the Acacia leaflet is a vehicle by which the fungus is conveyed to the tea. Unfortunately, it is not the only vehicle, as inoculation experiments have demonstrated that spores produced by the fungus will germinate readily in distilled water and will infect tea, Acacias and other plants. During suitable weather conditions, the disease spreads rapidly owing to the dispersal of the fungus spores by the wind and to the falling of the diseased Acacia leaflets.

It is a matter of common observation that the disease occurs only during wet weather and stops when the monsoon rains cease. Very humid conditions are necessary for the active growth of the fungus, and it is probable that the distribution of the disease is, to a large extent, dependent upon climatic conditions. It is, however, inadvisable to extend the area in which Acacias are grown. Trees immune to *Cercospora* are to be preferred for interplanting with tea, despite the known great agricultural value of Acacias.

A problem which requires elucidation is "how does the fungus *Cercospora* survive the dry periods between the monsoons?" That it does survive is evident, but how? and where? are not so apparent. Some

light has been thrown on this problem by the development in cultures of a further stage in the life history of the fungus. In culture, *Cercospora* produces perithecia and ascospores, which at present are unknown in nature. Indubitable proof has been obtained that these ascomycete fructifications are a further stage in the life history of *Cercospora*, and that the spores produced within the perithecia will readily infect tea, Acacias and *Albizzia lophantha* and cause the same symptoms as will the conidia commonly produced by *Cercospora Theae* in nature. The experiments also indicate that the passage through the ascomycetous stage rejuvenates the fungus, and possibly makes it more virile. The experiments have not advanced sufficiently far to be absolutely definite on this point, but the matter will be further investigated. A distinct advance has been made, however, inasmuch that we now know that *Cercospora Theae* has another stage in its life history, and we also know what it looks like, though we do not know where it is formed. It is probable, however, that in this stage the fungus is able to survive the dry periods. It is possible that the fungus also survives as a mycelium within the Acacia and other trees it attacks. This aspect of the question will also receive attention.

The perithecia are formed very readily on sterilised Acacia leaves and young shoots, but, as already stated, they have not been found in nature. They occur as small red or reddish yellow spheres about the size of pins' heads. Search is being made in the trees and also among fallen leaves for these fructifications. Superintendents would greatly assist in these investigations if they would submit for examination any such fructifications they may find on shade trees or tea where the disease occurs.

Spraying of tea as a preventive of this disease is impracticable because *Cercospora Theae* attacks only the very young actively growing leaves, in short, the flush. The only obvious preventive treatment is the removal of Acacias and other susceptible shade trees from the tea. There are, however, many objections to this treatment, the chief of which is the difficulty of substituting a known immune tree for the Acacias. A number of estates have experimented with the introduction of *Albizzia lophantha*, and it was hoped that this tree might prove suitable for planting where Acacias are removed. Unfortunately, experiments in the laboratory have proved that *Albizzia lophantha* is equally susceptible to the *Cercospora* disease as are the Acacias. Observations in the field fully confirm the results obtained from laboratory experiments. Consequently, the extended use of *Albizzia lophantha* for shade or green manure in districts where the climatic conditions are favourable for *Cercospora Theae*, is inadvisable from a mycological point of view.

Chlorosis of Tea :—In the Year Book of the Department of Agriculture, Ceylon, for the year 1925, a Witches' Broom disease of tea was described by Mr. Park, Assistant Mycologist to the Department. The principal symptoms ascribed to this pathological conditions are :—

1. The formation of tufts of shoots which give the disease its name "Witches' Broom."
2. The presence of small shoots with short internodes and dwarfed leaves.
3. The development of lateral branches from almost every bud of certain shoots which have been allowed to grow up. These branches usually lie in one plane.

4. The leaves are smaller than those of healthy bushes and are mottled green and yellow ; in extreme cases the whole leaf may be yellow.

No organism was found associated with the disease, which was ascribed to pathological causes possibly connected with the soil. The possibility was recognised that the symptoms by which the disease is known may be the result of more than one cause.

An opportunity was afforded the present writer to investigate a disease of tea which in many respects resembled that called " Witches' Broom," but the main character of that disease, viz. the formation of tufts of shoots, was absent. The most noticeable character was the yellowing of the leaves. In advanced cases all the leaves as well as the young shoots which normally are green, were yellow. The first sign of the disease was a mottling of the leaves ; the veins remained green, but the areas between the leaves turned yellow. As the disease advanced, the leaves became smaller and turned yellow. Small shoots with crowded internodes, bearing small leaves at the apex, were also present ; these somewhat resembled the spurs produced by some fruit trees. Stems which had been allowed to grow up produced branches at every node and these lay more or less in one plane. These symptoms agree with numbers 2, 3, and 4 listed above for Witches' Broom disease. The fact that every bud on certain shoots begins to grow shortly after it is formed appears to be of more importance than that the branches so formed lie in one plane. Normally, a large number of buds on healthy tea plants remain dormant ; they are capable of growth but are prevented from doing so, possibly by some deterrent secreted by the actively growing leaves or stems. The removal of the actively growing stem, as by plucking or pruning, and the consequent removal of the deterrent, results in the development of some of these dormant buds. The abnormal development of all buds on tea stems must therefore be regarded as a pathological condition.

A specimen has also been received from another estate which showed the abnormal branching, but there was no indication of the yellowing of the leaves or of any formation of tufted branches characteristic of " Witches' Broom." It seems possible, therefore, that the symptoms described by Park include at least three distinct diseases ; tufted branches or " Witches' Broom " being characteristic of one, the yellow and dwarfed leaves of the second, and the abnormal branching being symptomatic of the third. They may all be present on the same plant and may possibly be the results of similar causes. In order to avoid any confusion on these points the name " Chlorosis " is suggested for the disease of which the yellowing of the leaves is the most prominent character. Park also records that it has been found difficult to grow shade trees and green manures in the area affected by Witches' Broom. In the area in which Chlorosis was seen, this observation did not hold good, as growing between the rows of diseased tea was an excellent stand of *Boga medeloa*. This indicates that the conditions resulting in the formation of Witches' Brooms are not exactly the same as those resulting in chlorosis, and affords a further reason for distinguishing these diseases by distinctive names.

A study of Chlorosis in tea is being made and the following brief notes will indicate the progress achieved up to the present time.

Chlorosis occurs in fairly well defined areas ; it results in a very great diminution of crop and the death of a large proportion of bushes. No

organism has been found consistently associated with the disease, and the cause is regarded at present as due to physiological factors probably connected with the soil. Plants do not show any sign of the disease during the early stages of their growth ; it rarely makes its appearance until the bushes have been centred. Then, the leaves become mottled and finally yellow. For this reason it becomes difficult to determine in the field whether the disease is spreading through infection, or whether new cases observed are merely bushes which have managed to survive longer before showing any ill-effects.

It appeared to be of prime importance to determine whether the disease is in any way infectious, as, should it prove to be infectious, very rigorous steps will have to be taken to eradicate it. At present, I am inclined to the view that it is not infectious, but is due to some physiological cause. Its spread, if any, is very slow, and consequently, conclusions based on field observations alone may be erroneous. It is, therefore, imperative that this question of infection be placed beyond all possibility of doubt.

With this object in view efforts are being made to propagate the disease in healthy soil, and to infect healthy tea plants without undue risk of carrying the disease into new areas. Unhealthy shoots from diseased tea were removed from the estate on which this problem is being studied, and a number of grafts were made on old tea within the Hakgala Gardens. Other diseased shoots were planted out in a nursery in order to ascertain whether the diseased shoots, if they can be induced to strike, will give rise to healthy plants.

For this work I am very greatly indebted to Mr. J. J. Nock, Curator of the Hakgala Gardens, who very kindly offered to carry out this work for me. Mr. Nock has successfully propagated healthy tea from cuttings ; and it will be interesting to see whether he can also induce these diseased cuttings to strike, and what will be their resulting growth. He also made twenty grafts on to healthy old tea in the gardens, but none of these has proved successful. It should be remembered that in these grafting operations he was using diseased scions and consequently a high proportion of successes was not to be expected. He has, however, generously offered to repeat the experiments. Without his technical knowledge and personal interest in the experiments, the possibility of obtaining definite results would be considerably reduced. Every care will be taken to prevent any spread, should the disease prove to be infectious.

The mottling of the leaves in the early stage suggests a " Mosaic disease." With such diseases the sap is infectious, and the infectious sap is usually carried from plant to plant by sucking insects. The infection experiments already referred to should throw some light on the question whether this is a form of "Mosaic." With some mosaic diseases the rate of translocation of starch in the affected stems is slower than in healthy stems. Experiments carried out to determine whether the chlorotic tea had a slower rate of translocation than had healthy tea from the same neighbourhood, showed clearly that the starch was removed quite as readily from diseased leaves as from healthy leaves. This indicates that there is no phloem necrosis of such a nature that it hinders the movement of starch in the diseased plants, and suggests that the disease is not truly mosaic in character.

Experiments with the saps of healthy and diseased plants have given very important results. The sap from healthy plants gave with colorimetric

tests a reaction of 4.6-4.8 in the pH scale. The pH of stems bearing mottled leaves showing early symptoms of the disease gave a reaction of pH, 5.2, while the pH of chlorotic stems with yellow leaves was found to be between 5.7 and 6.0. These tests have yet to be verified, but the difference in reaction of the saps is sufficiently great to indicate that the sap of the diseased stems is markedly less acid than that of healthy plants. The results suggest further lines of research, not only into the cause of the disease but also into the successful treatment of it.

So far, studies in this disease have been confined to one estate only, although it is suspected that the disease occurs elsewhere. Now that some progress has been achieved in these investigations, it would be of great assistance if Superintendents would report to the Tea Research Institute the occurrence of chlorotic tea on their estates, so that the area under investigation may be widened, and experiments carried out to determine the best treatment under different conditions.

Wood Rot or Branch Canker:—Continued attention is being paid on most estates to the question of rotting back of the wood exposed through pruning. This is one of the major problems of a pathological nature in the cultivation of tea in Ceylon at the present time, and is one to which both the Institute and the Department of Agriculture are devoting attention. In order to avoid overlapping, the Institute is confining its researches to the disease as it occurs in up-country estates where it is not associated with termites. It is not suggested that the problem in up-country tea is entirely different from that at lower elevations, but as will be shown later, it appears possible that the organisms which cause the disease up-country may be different from those doing similar damage at lower elevations.

Nothing is known at present of the individual organisms which are responsible for the decay of tea wood. A detailed knowledge of these organisms will possibly indicate the most suitable method of preventing their ravages. Eleven isolations have been made from rotting tea wood from different up-country estates and seven different organisms have been isolated. No two estates yielded the same organisms. This suggests that more than one fungus is responsible for the rotting of tea wood and indicates the possibility that the active organism in one district is not the same as that causing the rot in another. Experiments are now being carried out to determine whether any or all of these organisms are capable of causing a rot of healthy tea wood. The fact that the organisms are present in decaying tea wood is no proof that they are capable of causing the decay. The isolations were made, in every case, from the advancing edge of the rot; in most cases these gave rise to pure cultures, so that there is the possibility that at least one will prove capable of rotting tea wood unaided. The organisms which prove capable of rotting tea wood will be used for controlled experiments in which the relative values of various antiseptics in the prevention of the disease will be investigated.

At present, coal tar is advised for use in the prevention of infection of pruning cuts. It must be admitted that its value as an antiseptic against wood rot of tea is not fully established, and that there are a number of objections against its use for this purpose. The whole of the evidence at present indicates that, in the great majority of cases, infection by organisms which leads to the rotting of tea wood and causes branch cankers occurs at the pruning cuts. It follows then, that some form of protection must be

given to those cuts until the wounds are healed over by natural growth. The artificial covering given to the pruning cuts to prevent the entry of rotting organisms must be weather proof and, to some extent, antiseptic. Tar has been used in arboriculture and horticulture for this purpose with considerable success. Also in experiments carried out in Java on tea, gas tar gave satisfactory results. Tar as received from the gas works, however, has a burning effect on the cortex with which it comes into contact. This burning may be minimised by washing the tar with water and pouring away the supernatant fluid before using the tar on tea. Washed tar is preferable to ordinary coal tar as received from the gas works for application on pruning cuts or wounds of tea. Stockholm tar has been proved to be unsuitable.

Cases have been seen in which a decay of the wood has occurred below tar. But in no case could it be guaranteed that the tar was put on to clean healthy wood within a few days of making the cut. It must be clearly understood that it is useless to apply tar to wood already infected. The object of application is to prevent infection, by killing the fungus before it enters the wood ; the tar will not necessarily kill the fungus already within the wood tissues. It has recently been shown that tar is not toxic to all fungi ; it has proved ineffective against *Stereum purpureum*, the cause of silver leaf disease in plums, etc. Infection with that fungus occurs as readily through gas tar as through unprotected wounds, and the hyphae of the fungus have been seen side by side with drops of tar in the vessels. This instance illustrates the danger of generalising in plant pathology, and it indicates the necessity for experiments to determine whether tar is toxic to the fungi causing wood rot on tea, and whether tar loses its toxicity soon or a long time after application. Definite experiments of this nature will be carried out with any strains of fungi found in the experiments recorded earlier which prove capable of rotting tea wood.

Meanwhile, experiments could be carried out in the field to determine the true value of gas tar and other paints in preventing wood rot. For this purpose, tea which is being cut back hard on to large wood would be most suitable. If estates which are cutting back bushes, collar pruning for preference, would communicate with the Tea Research Institute and offer a few bushes for experiment, trials with different paint mixtures could be made. At present, the Institute has no tea of its own with which to experiment, so the co-operation of interested estates is requested.

There appears to be a misapprehension in some quarters as to the purpose of gas tar or other similar applications. The object of applying gas tar to the pruning cuts is solely to prevent infection by invading organisms. The tar is not intended to encourage healing, but merely to keep the wood healthy while the healing process progresses. The application of tar or any other thin dressing on the cut surface of a wound is unlikely to promote healing. The natural healing of a wound is brought about by a growth of tissues originating at the cambium on the perimeter of the wound, and spreading inwards until the wound is completely covered by tissue which prevents the entry of water and invading organisms. The natural healing process is, therefore, one of growth for which food material is required. Tar or other external dressings cannot provide the bush with this food material ; it must be obtained from the soil by the roots, and from the food reserve accumulated by the bush. Natural healing on most estates is a very slow process, and unfortunately on many others it is almost negligible. Some

means of warding off attacks by wood rotting fungi is, therefore, necessary until the plant can form its own natural protection. It is for this reason that the use of tar is advocated.

Even on estates where the healing of wounds is comparatively rapid, some protection is necessary where the wounds are made on branches of large diameter. Healing starts from the edges of the wounds, but the rot usually starts at the centre. The two processes are distinct and there is no evidence of any correlation between them. Consequently the last part to be covered by the natural heal is the part most liable to be attacked by the wood-rotting organisms. For this reason the wound must be protected against invasion until the normal healing callus can cover it.

Effective prevention of wood rot in tea necessitates two distinct processes :—

1. The encouragement of healing by the application of suitable fertilisers and by the accumulation of food reserves within the plant before pruning.
2. The protection of the wounds by suitable antiseptic covers which will prevent the entry of rotting organisms until the wounds can be healed by the natural process.

Seedling Diseases :—A few cases of seedling diseases have been investigated during the period under review, but the cause or causes still remain obscure. A number of organisms have been isolated and these are being tried on healthy seedlings in order to ascertain whether they will invade the plants and give rise to characteristic disease symptoms. It has already been pointed out by Petch that in many cases the primary cause of seedling diseases is unsuitable soil conditions, and that it is only when these conditions occur that the fungi associated with the disease become parasitic. If that is true, and there is no reason to doubt it, it is likely that many organisms associated with seedling diseases will fail to reproduce the symptoms when inoculated on seedlings growing under healthy conditions, even though the organisms may have been closely connected with the death of the seedlings from which they were isolated. For this reason a very definite knowledge is required of what constitutes suitable soil conditions for tea nurseries. Such conditions are at present unknown, except such as may be stated in very general terms. It seems unlikely to the writer that those conditions can be ascertained by physical and chemical analyses of the soil, until an intimate knowledge of the exact requirements of the healthy plant have been ascertained.

Some diseases are capable of successfully invading healthy plants and causing their death even when the optimum conditions are provided for the plant; others can invade plants only when the external conditions are not quite suitable for the plant, *i.e.*, when some adverse condition occurs. The majority of tea seedling diseases appear to belong to the second category; the plants succumb to the attacks of organisms which they would successfully resist if they were older and sturdier, or growing under ideal conditions. This is, of course, what might be expected, as most young, whether animals or plants, are very susceptible to disease. It indicates, however, that in the study of seedling diseases an intimate knowledge is required of the exact requirements of the plants as well as a knowledge of the organisms likely to attack them. For this reason experiments have been started to ascertain what are the necessary conditions for the optimum growth of tea seedlings.

Physiological Experiments :—It will be evident from the foregoing that the causes which result in the exhibition of disease symptoms on tea plants, or any other plant for that matter, may be obscure until the requirements of the healthy plant are known accurately. I will enumerate a few of the purely physiological problems which have arisen during the investigations covered by this report. Why is the sap of chlorotic tea less acid than that of healthy tea, and how is the acidity of the sap of a tea plant affected by the acidity of the soil? Where are the reserve materials stored in the tea plant, and to what extent do they influence the rate of healing of pruning cuts. What are the optimum requirements for the growth of tea seedlings? These and other physiological problems have an intimate bearing on the pathological problems under investigation, and for that reason I have ventured to initiate experiments of a purely physiological nature to elucidate them. The experiments have not progressed sufficiently far to afford any definite results as yet, so they will be mentioned here but briefly.

Acidity of Sap and of the Medium surrounding the Roots :—It is well-known that different wild plants have different soil requirements. Some prefer an acid soil, and such weeds are often accurate indicators that the soil is acid or sour, while others prefer an alkaline soil. It appears probable that the degree of acidity of a soil to a large extent determines the type of flora that will grow on it. Cultivated plants also have specific requirements, and a soil which may be too acid for one crop may be ideal for another. It is now generally recognised that tea prefers an acid soil, and that on some soils large applications of lime, which materially reduce the acidity, may be detrimental to tea. Cooper (Ind. Tea Assoc. Sci. Dept. Quart. Journ. 1925. pt. IV. p. 130) states "Lime certainly encourages the growth of arhar greatly while slightly discouraging the growth of tea. Plots receiving the larger dressings of lime therefore show generally the largest crops of arhar and the greatest loss of crop of tea." The loss of tea crop is due no doubt to the increased competition of the green manure, but it indicates also that the lime applications have altered the soil in such a way that the alteration has benefitted the green manure more than it has the tea. The obvious conclusion is, therefore, that arhar prefers a less acid soil than does tea.

The question "what are the optimum requirements of tea as regards soil acidity?" still remains. Until such requirements are determined and stated definitely in absolute, rather than in relative, terms, it must remain impossible to state with accuracy whether a certain soil is or is not suitable as regards its acidity, for the maximum growth of the tea plant. It appears probable that a soil which is alkaline or insufficiently acid may give rise to pathological characters, and it is suggested that the disease here described as Chlorosis of tea is a case in point.

Experiments have been started, therefore, to ascertain what degree of acidity in the soil is required by the tea plant in order to achieve maximum growth. At present the experiment is confined to the culture of young plants in water culture solutions of varying degrees of acidity. It is not expected that these experiments alone will solve the problem, so other experiments are being devised to obtain further evidence.

It is hoped to be able to use the material afforded by the above experiments to determine to what extent the acidity of the plant's sap is affected by the variations of the pH of the culture fluids.

Storage of Food Materials:—Another problem which has been started is an investigation into the nature and location of the food materials stored by the tea plant. The plant must be dependent, to a great extent, upon these reserves for all growth made after heavy pruning. Food materials supplied as manures at the time of pruning cannot of themselves be sufficient, as a certain amount of elaborated foods is necessary for the immediate growth of new shoots and leaves. Bushes having good reserves should make better and quicker growth than those in which the reserves are low. It seems, therefore, to be of considerable importance to determine how and where these reserves are located, whether variation occurs during growth, and what is the effect of different manurial systems on these reserves. This constitutes a large piece of work, but the above investigation has been commenced as a preliminary.

These investigations will be continued and others commenced as time and opportunity afford.

C. H. GADD,

Mycologist.

REPORT OF THE BIOCHEMIST.

I started work at the Institute on the 8th September, 1926, and proceeded to set up the nucleus of biochemical laboratory. Apparatus has been adjusted and calibrated, and the usual reagents required in routine work prepared, but a comprehensive programme of work could not be undertaken, owing to lack of a suitable water and heat supply, and some of the necessary apparatus. A further supply of chemicals and apparatus has been ordered from England.

A few local estates have been visited, and their manipulation of the plucked leaf in the process of tea manufacture observed.

As a preliminary to future work, the literature of the chemistry of tea and its manufacture has been examined, so as to ascertain the trend of research work in other countries, and to glean the known facts of the chemistry of tea. It is clear at the outset that, apart from the estimation of total water-soluble constituents, tannin, ash, and total nitrogen content, very little is known of the composition of the tea leaf, and most of the work done has been devoted to the estimation of these constituents at different periods in the life of the plant, and during the process of the manufacture of tea.

A qualitative analysis of the leaf has been started to determine what substances are present, which may play some part in the chemical changes during the making of tea, apart from the changes occurring in the tannin. Work is also being carried out on the acidity of the aqueous extracts, as the reaction of the juice is of importance if the fermentation of the leaf is due to oxidising enzymes, the activity of which depends very much on the reaction of the medium they act upon.

In order to study the biochemical changes taking place in living material it is necessary to have suitable methods of analysis, which can be carried out with the ease required to cope with a large number of estimations and

accurate enough to detect small changes of concentrations. The methods of analysis employed by other workers are not quite clear, as this important item is generally omitted from the papers read, and the results given by different authors, even for the water-soluble constituents, vary considerably. Work has, therefore, dealt mainly with the application of standard methods of analysis to tea material, and the determination of any modifications required.

The material investigated is heterogeneous, and an important question in any experimental work of this nature is how far the sample taken for analysis is a true representative of the whole. The difficulty is overcome by duplication and careful sampling, but, however often the samples are duplicated, complete elimination of this error is not practicable, and in order to know the significance of any results it is necessary to determine the sampling error. This is being determined, as well as the most suitable number of samples required to bring the results within experimental accuracy.

Apart from these preliminary investigations, which are considered of fundamental importance for future work, a study is being made of the variation in moisture content of the fresh plucked leaf, and the effect of withering on the water-soluble constituents. Thanks to the management of The Scrubs Estate it has been possible to make arrangements to commence a chemical survey of plucked leaf from a field coming into bearing from pruning, so as to determine the seasonal changes met with in the leaf.

D. I. EVANS,
Biochemist.

REPORT OF THE ENTOMOLOGIST.

A preliminary course of study, extending over about three weeks, was undertaken in May, at the Department of Agriculture, Peradeniya, with a view to obtaining a general knowledge of the chief insect pests of tea. I should like here to express my indebtedness to Dr. J. C. Hutson and the staff of the Entomological Division of the Department of Agriculture, for the kind assistance that they have rendered me in many ways.

Advisory work was commenced at the beginning of August. 149 letters have been received, of which 38 were accompanied by specimens of insects or damage; one-third of the enquiries were about shade trees and other plants, and the remainder in connection with tea. 157 letters have been sent out.

Collections:—Both pinned and spirit collections have been commenced of the insects and other pests attacking tea and the various shade trees and accessory plants grown on tea estates. These are being supplemented, where possible, by actual specimens of damage caused to the plants in question.

A number of injurious insects have been bred out in the laboratory from material taken in the field. In this connection, particular attention has been paid to the natural enemies of various pests, in the form of parasitic and predatory insects. Parasites have been bred from most of the pests encountered, and these have been preserved for future identification.

Library :—A catalogue of references to all literature on the pests of tea and accessory plants has been started, and is being supplemented from time to time.

Touring:—In all, 39 estates in various districts have been visited during the past half-year. A series of preliminary tours of inspection has been conducted in the following districts :—Ratnapura, Matale, Uva (Lower and Central) and Maskeliya : other districts visited include Bandarawela, Haputale, Kotagala, Nanuoya and Uda Pussellawa.

TEA.

Tea Tortrix (*Homona coffearia* Nietn.) has been unusually active this year. In Maskeliya particularly, most of the estates have suffered to a greater or less extent ; some estates have been visited this season that have been free from Tortrix for a number of years previously. The sharp, concentrated attacks of earlier years appear to be giving place to milder outbreaks spread over considerable areas, making the task of control an increasingly difficult matter. Tortrix appears to be steadily enlarging its range of food-plants, as evidenced by the great number of wild and cultivated forms showing damage that are encountered everywhere in the infested regions.

A special tour of investigation was undertaken in the Maskeliya district.

Shot-hole Borer (*Xyleborus fornicatus* Eichh.):—Occasional reports of Shot-hole Borer on young tea have been received, but it is evident that appropriate manuring is proving, to a large extent, effective in combating the attacks of this insect.

Nettle Grubs :—The usual outbreaks have occurred in the Passara district. In the case of an attack by one of the smaller species, *Spatulicraspeda castaneiceps* Hmps., the outbreak had evidently been dissipated mainly by the agency of natural enemies, for of the few grubs still to be found on the bushes, the majority were parasitised, while a number showed signs of "wilt" disease. An outbreak of the Green Nettle Grub (*Thosea cana* Wlk.), in the Low-country, was entirely wiped out by an Ichneumon parasite. Judging by the specimens sent in, fully 90% of the grubs were parasitised.

Purple Mite (*Eriophyes carinatus* Green.):—Of the four species of mites recorded as attacking tea, Purple Mite has been observed far more commonly than the other three. In particular, the whole of the Uva region that was visited showed abundant signs of this mite ; on one unusually badly infested estate, living mites were actually observed feeding on the flush. This species, however, appears to cause little damage beyond, possibly, weakening the constitution of the tea bush to some extent.

Scarlet Mite (*Tenuipalpus obovatus* Donn) :—Outbreaks of this mite, which is undoubtedly the most formidable species, have been reported from various districts, especially from Matale, Badulla and Passara ; in some cases bushes have been actually killed out as a result of attack. In one instance, supplies suffered so badly that one portion of the estate had been supplied four or five times without success. A "die-back" of the

young shoots, accompanied by a blackening of the stems, observed on a Badulla estate, appears to be traceable to the presence of Scarlet Mite. It is a noticeable feature that attacked bushes do not occur "*en bloc*," but are scattered here and there throughout infested fields. This is possibly explained by the fact that fallen leaves have been observed to bear numbers of living mites, so that wind-blown leaves may be the cause of random infection.

Yellow Mite (*Tarsonemus translucens* Green) was observed in some abundance in Maskeliya; it did not, however, appear to be causing any appreciable damage, although the actual loss in yield that is caused by the hardening of the younger leaves, which so often accompanies mite attack, is not easy to estimate.

NURSERY PESTS.

Red Borer (*Zeuzera coffeae* Nietn.):—Several outbreaks have occurred in various districts, especially amongst young nursery plants: but pruning back the affected stems, with prompt destruction of the grubs, has prevented any extensive loss.

Cutworm or Black Grub (*Agrotis ypsilon* Rott.):—Attacks on nursery plants have led to the commencement of experiments with leaf-baits and poison baits for the control of this insect.

Preliminary trials with leaf-baits indicate that both Cabbage and Sweet Potato leaves, especially the latter, may be used to advantage in trapping the cutworms. Poor results were obtained with Dadap leaves, and also with conical pits formed in the soil, as at one time recommended in this country. The experiments referred to were conducted from October to December, the trials with Cabbage leaves and pits continuing for 10½ weeks, and those with Sweet Potato and Dadap leaves for 9 weeks. The following figures show the total number of grubs taken on the experimental beds during the above periods:—

{ 2 beds Cabbage leaves	..	..	149
{ 2 beds Pits	..	..	10
{ 1 bed control	..	..	16
{ 2 beds Sweet Potato leaves	..	..	252
{ 1 bed control	..	..	57
{ 1 bed Dadap leaves	..	..	1
{ 1 bed control	..	..	6

The beds used for Dadap and Sweet Potato trials were somewhat smaller than the remaining beds.

These trials, being conducted only on a small scale, give no more than an indication of the respective merits of the methods employed, but they certainly provide some evidence of the possible value of Sweet Potato and Cabbage leaves as baits for cutworms.

In practice, the leaves should be spread over the beds between the plants a few inches apart, and examined early each morning for cutworms sheltering beneath the leaves.

Eelworm (*Heterodera radiculicola* Greef.):—Considerable damage has been caused by this pest to nursery beds in the Badulla District. As a result of the impending loss of nearly the whole of the young seedlings in one estate, various experiments have been instituted in an effort to save at least a portion of the infected plants. These experiments include attempts at soil disinfection, and the treatment of plants removed from the soil, with a view to replanting in soil free from infection.

Other pests of tea that have been sent in include Brown Bug (*Saissetia hemisphaerica* Targ.), Lobster Caterpillar (*Stauropus alternus* Wlk.), Red Spider (*Tetranychus bioculatus* W.M.) and Small Bagworm (*Psyche albipes* Mo.). It is interesting to note that on two occasions reports have been received of attacks on tea by the common Albizzia caterpillar (*Terias silhetana* Wallace).

DADAP (*Erythrina lithosperma* Bl.)

Dadaps appear to be particularly susceptible to pests and diseases in the Uva district.

Dadap Weevil (*Mylocherus curvicornis* F.), a small, grey beetle, about one-third of an inch in length, is extremely abundant and widespread, and causes extensive damage by riddling the foliage and producing a typical saw-edge appearance in the margin of the leaf. Although concentrated attacks seldom or never occur, it is evident that the insect destroys a considerable weight of green manure. It is possible that the weevil breeds in the decayed stumps of branches that have "died back" after pruning, since adults have been frequently seen in this position. It has also been observed (rarely) to be feeding on tea shoots.

Attacks on dadaps by Shot-hole Borer were observed in some districts. Young shoots are ringed by the galleries 2 or 3 feet from the growing point, and finally break and hang over in a brown, dead condition.

ALBIZZIA LOPANTHA.

This recently introduced species has been recorded as suffering severely from the attacks of Tea Tortrix and other leaf-eating caterpillars in Maskeliya, where many young plants have been entirely destroyed.

A species of mealy bug has been found on the roots of two-year-old plants in the Nanuoya district. Incidentally, these plants were dying out from an unknown cause, but it is unlikely, owing to the small number of insects present, that they had contributed to the death of the plants. At the same time, this insect should be noted as a possible source of injury in the future.

ALBIZZIA Spp.

Numerous reports have been received of attacks by the caterpillars of the very common yellow and black butterfly, *Terias silhetana* Wallace, which often strip the Albizzia foliage to a considerable extent. These caterpillars are some times found to be parasitised to an appreciable degree by a Tachinid fly, the grub of which develops inside the caterpillar and emerges from the body when ready to pupate. Seedlings from a Passara estate were found to be attacked by Eelworm (*Heterodera radiculicola* Greef.) which formed well-developed nodules on the roots.

GLIRICIDIA MACULATA H.B. & K.

Attacks by Shot-hole Borer and a scale insect (mealy bug) have been reported. In the case of the latter a sooty mould, covering the leaves, follows the attack, living on the excreta produced by the scales, as in the case of Green Bug and Brown Bug. In a very severe attack, the tea bushes immediately beneath the affected trees also receive the sooty mould, and this has been reported (in one instance) to have set-back their development after pruning. Presumably, the combined deposits of excreta and mould interfere with the respiration from the surface of the leaves, and thus produce the above effect. At the same time, it must be clearly understood that the mould does not, as is frequently supposed, feed on the leaf substance, but on the droppings of the insects, which are themselves true parasites.

To prevent the spread of this pest, all signs of the small, white insects or the sooty mould should be cut out as soon as they appear. Where the trees are badly affected, all the foliage should be pruned off and buried well beneath the soil.

BOGA MEDELOA (*Tephrosia candida* DC.)

This green manure plant, like other low-growing leguminous forms, is extremely susceptible to the attacks of insects. The pod, in particular, is favoured by the attentions of numerous pests, conspicuous amongst which are the Tephrosia Beetle (*Araecerus fasciculatus* De Geer), and the caterpillars of several species of moths, notably *Maruca testulalis* Geyer and *Etiella zinckenella* Tr. Thus on estates where Boga is grown for seed, considerable loss has been incurred, and more than one estate has lost its entire seed-crop for two consecutive years.

Specimens of seedling plants that were sent in for examination from one estate showed injury resembling that caused by Eelworm (*Heterodera radiculicola* Greef.) These seedlings, planted out in terraces, were being killed out rapidly at the time of observation.

The life histories of the more important enemies of Boga have been worked out, with the exception of the periods involved by the successive stages of the insects, which will be ascertained in due course.

S. STUART LIGHT,
Entomologist.

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Department of Agri-
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- Foex, E.
Fryer, J. C. F.
- Gadd, C. H.
Gadd, C. H.
- Gadd, C. H. & Jepson
F. P.
- Greaves, J. E.
Greaves, J. E. & E. G.
Green, E. E.
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Haas, P. & Hill, T. G.
- Hall, A. D.
Hall, A. D.
Hall, A. D.
Hanna, W. F.
- Harshberger, J. W.
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TEA RESEARCH INSTITUTE OF CEYLON EXPENDITURE ACCOUNT
FROM 13TH NOVEMBER, 1925, to 31ST DECEMBER, 1926.

Administration of the Board :—

	Rs.	c.	Rs.	c.
Office rent and salaries	2,400	00		
Secretary's Salary	3,200	00		
Travelling Expenses of members of Board and Secretary	1,007	19		
Cables and Telegrams	767	98		
Stationery and Printing	1,612	94		
Advertising	222	16		
Postage	151	85		
Telephone Rent and Trunk Calls	209	25		
Bank Commission and Cheque Books	101	41		
Legal Expenses	26	25		
Sundries	20	32	9,719	35

Personal Emoluments of Scientific Staff :—

Salaries	45,009	65		
House Allowances	4,160	59	49,170	24

Laboratory Expenses :—

Apparatus and Chemicals	8,141	70		
Storage, Landing Charges, etc.	422	05		
Furniture and Alterations	2,628	07		
Library	1,807	90		
Rent and Taxes	1,150	80		
Upkeep and General Expenses	549	85	14,700	37

Laboratory Office Expenses :—

Salaries	377	56		
Cost of Typewriter	380	00		
Furniture and fittings	654	45	1,412	01

Travelling Expenses of Staff :—

Expenses paid to Laboratory Staff	1,372	75		
Cost of Motor Car	4,830	00		
Cost of New Garage	725	00		
Chauffeur's Wages and Expenses	665	00		
Motor Running Expenses, Insurance, etc.	1,012	87	8,605	62

Contingencies :—

Tocklai Expenditure	2,234	50		
Staff Passages	3,515	18		
Sundries	32	39	5,782	07
			89,389	66

THE TEA RESEARCH INSTITUTE OF CEYLON.

INCOME AND EXPENDITURE ACCOUNT FROM 13th NOVEMBER, 1925 TO 31st DECEMBER, 1926

EXPENDITURE.		INCOME.	
	Rs. Cts.		Rs. Cts.
To Expenditure as per attached statement ..	89,359 66	By Cess collected and handed over by the Government at the rate of ten cents per one hundred pounds of tea exported.	238,519 42
„ Balance, being excess of Income over Expenditure as per Balance Sheet ..	150,441 80	„ Bank Interest ..	1,312 04
Rs.	239,831 46	Rs.	239,831 46

BALANCE SHEET AS AT 31st DECEMBER, 1926

LIABILITIES.		ASSETS.	
	Rs. Cts.		Rs. Cts.
Sundry Creditors ..	600 00	Sundry Debtors ..	1,351 70
Planters' Association of Ceylon ..	7 14	Ceylon Association in London ..	6,831 26
Surplus Account, being Excess of Income over Expenditure to 31st December, 1926	150,441 80	National Bank of India Ltd.— Deposit Account Rs. 100,000 00	
		Current Account Colombo „ 42,357 30	
		Do Nuwara Eliya „ 464 72	142,822 02
		Cash-in-hand ..	43 96
Rs.	151,048 94	Rs.	151,048 94

Colombo, 9th March, 1927.

Audited and found correct.
(Signed) FORD, RHODES, THORNTON & Co.,
Chartered Accountants.

